Statement of Work

For

Expansion of Voice Communication System Capabilities

At

The Airspace Operations Laboratory
NASA Ames Research Center

1   Purpose:

The purpose of this document is to describe the work required to expand the capabilities of the current voice communication system (VCS) in the Airspace Operations Laboratory (AOL) at NASA Ames Research Center.

2   Background:

Simulating air traffic operations is challenging. Complex interactions between air traffic controllers, flight crews, traffic managers, airline operators and their respective automation systems result in the organized or chaotic movement of thousands of aircraft through the airspace. Covering all the potential interactions in simulation is impossible. Therefore, each simulation has to be designed to cover those aspects that are relevant to answer particular research questions. Realizing the vision for the Next Generation Air Transportation System (NextGen) outlined by the Joint Planning and Development Office (JPDO) requires simulations to address numerous research questions. The Airspace Operations Laboratory (AOL) at the NASA Ames Research Center has been designed for studying air traffic operations in the current-day environment, possible NextGen environments as well as the transitional stages between now and then. The AOL provides an environment for rapid-prototyping of operator displays for ATM research, and does so through Human-In-The-Loop (HITL) simulations.

Until 2010, the AOL's facility for conducting these simulations had up to 21 ATM positions, nine pilot positions, and four experiment control positions, divided across five separate rooms.

Figure 1: AOL facility overview (before 2010).
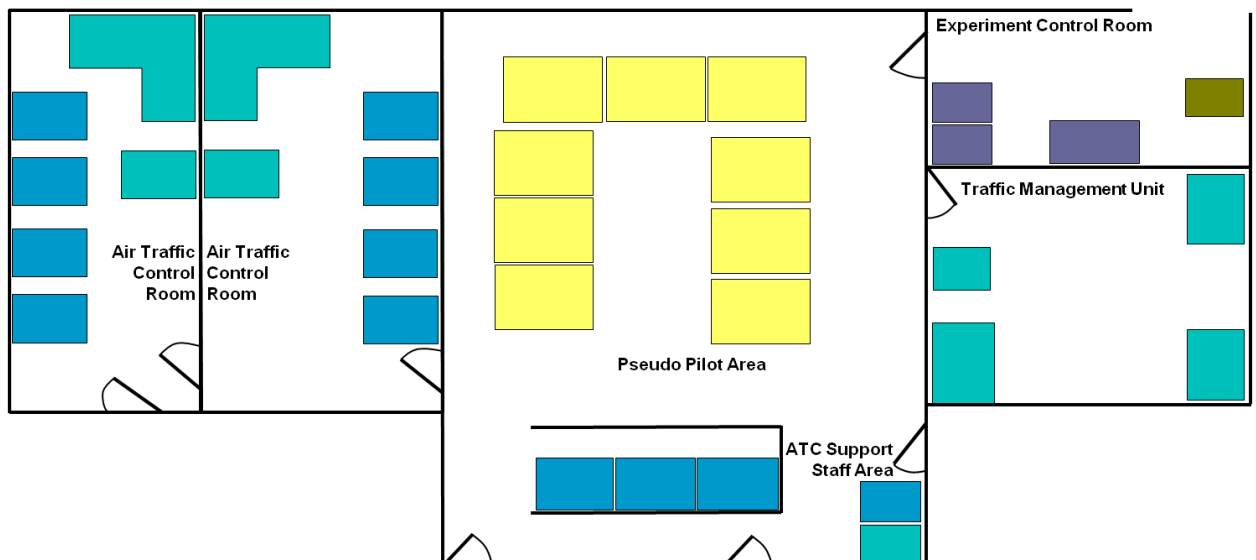
In 2010 the AOL started the expansion of its facility, to have the ability to conduct simultaneous and independent simulations researching, for example, Terminal arrivals and En Route separation assurance projects. This required a significant increase in the number of operator stations available. With its expanded facility, the AOL can conduct simulations incorporating up to 19 Air Traffic Control (ATC) radar positions, 15 Air Traffic Management (ATM) positions, 7 ATC support positions, 19 pilot positions, and eight experiment control positions, divided across two main areas with a total of 10 separate rooms. Currently the H211 area is fully equipped, while the 280 area has undergone HVAC construction work and is in the process of being re-equipped.

Figure 2: AOL facility overview (present).
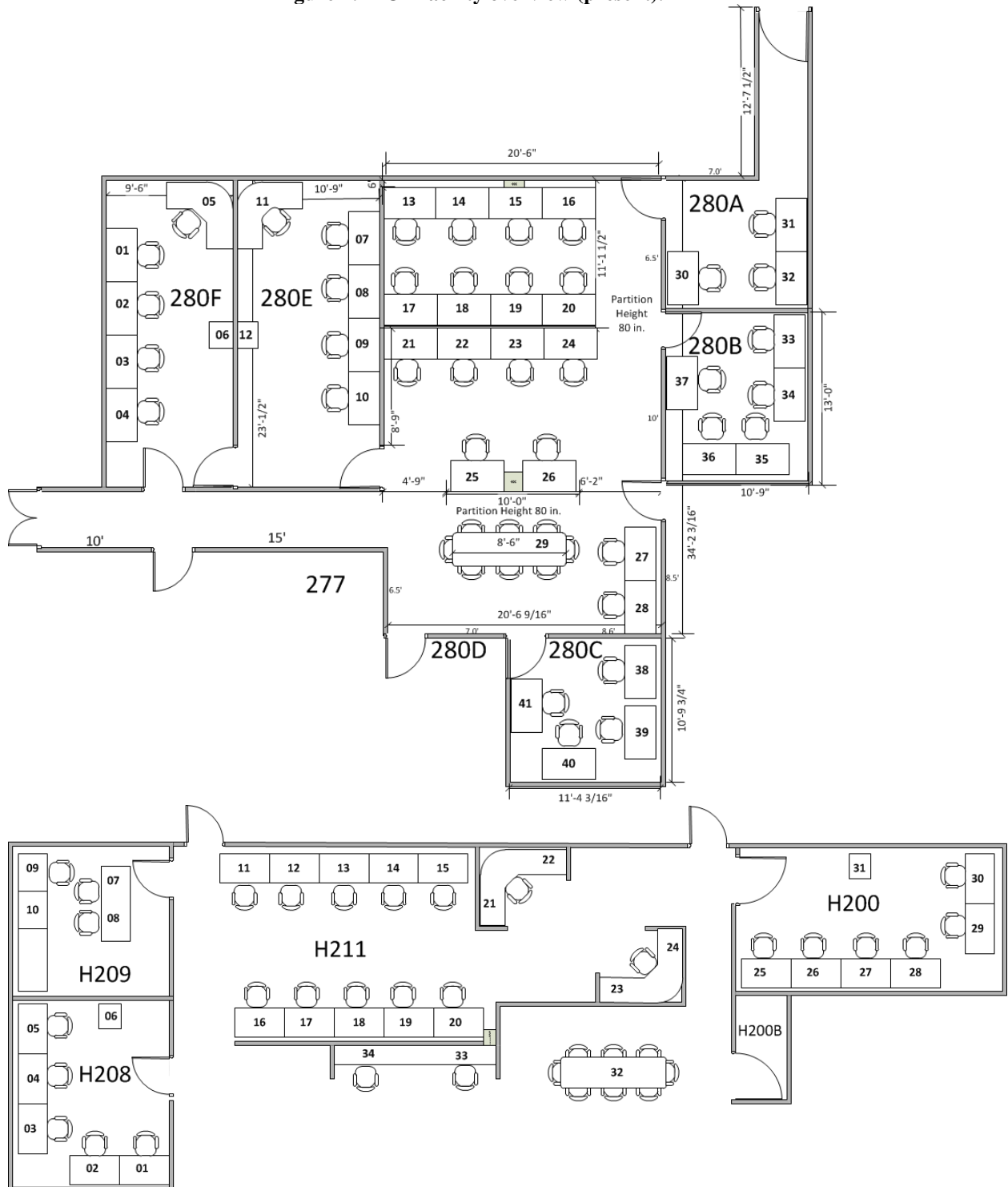
The AOL's main areas can be used to run independent simulations, or can be combined into one simulation. This layout also allows for the integration of area supervisors and traffic managers into the simulation. Research expanding from the tactical air traffic control domain into the area of multi sector planning and dynamic airspace management, required the simulation of additional communication paths. In today's FAA facilities, air traffic control areas have front line managers to supervise the operations in the control room and coordinate with other supervisors and traffic managers. The actions of the supervisors and the Traffic Management Unit (TMU) have a major impact on the air traffic control operations. When the first simulation in the AOL included an area supervisor and traffic management coordinators, it became obvious that these positions added significant value to the fidelity of the operations. Not only was the staffing necessary, because these positions were data collection positions, but also the air traffic controllers received additional support. Each air traffic control room can now be treated as area of specialization in a facility that has a supervisor and can coordinate with other areas and TMUs as necessary. In Figure 2, rooms 280F, 280E, H200, and H208 are the AOL's four air traffic control rooms.

The current VCS in the AOL, custom built and installed by Quintron Systems, does very well at supporting simulations with several paths of communication. AOL researchers developed specifications and requirements that allowed Quintron to use their DICES VoIP (an internet protocol based voice communication system) product as the basis for an emulation of the FAA's Voice Switching and Communication System (VSCS). The most important functions and interactive features for air/ground and ground/ground voice communication were specified in great detail and engineered into a PC-based environment. The voice application at the air navigation service provider (ANSP) stations was integrated into separate tablet PCs' with touch screens and USB based headsets, foot switches and speakers. The voice application for simulation pilots or confederate controllers usually runs on the same PC as their primary workstation. Figure 3 shows a controller station in the AOL equipped with the VCS, and Figure 4 shows a typical VCS screen layout for a small scale simulation with an air/ground communication page on the left, and a ground/ground communication page of the right.

Figure 3: Current VCS in the AOL

Figure 4: Example VCS screen layout.

The voice communication system enables participants in the AOL to conduct ground/ground coordination via direct calls and conference calls and therefore adds an important element to the laboratory environment. This coordination element had been poorly modeled in the past. When the first simulations were conducted using the new voice communication system, it not only raised the fidelity of the simulation environment substantially, but it also required researchers and study participants to address important coordination aspects. New insights have been gained in various research focus areas about coordination requirements and associated workload as well automated aids to facilitate better coordination in NextGen operations. The system was built to emulate many of the functionalities of the VSCS installed throughout air traffic control facilities in the US, so that controllers are already familiar with its behavior.

The current VCS is able to support the AOL's simulations with the following capabilities:
- The current VCS can support a maximum of 32 voice clients.
- The current VCS can organize the voice clients into four workgroups.
- The current VCS can support a database of a maximum of 250 configurable circuits.

3   Scope:

This project will require the contractor to deliver all equipment, hardware, software, supplies, materials, other than Government Furnished Equipment (GFE), travel, expenses, and labor necessary to satisfy the requirements of this Statement of Work (SOW) including design, installation, testing, and training on the VCS.

For the purposes of this Statement of Work, VCS only applies to voice communication.

On-site work, including installation, testing, and training shall be provided at mutually agreeable dates and times. In order to minimize the impact to on-going simulation experiments it is anticipated that some portion of time allowed on site would be other than normal working hours of 8 a.m. to 5 p.m., Monday through Friday.

Support for all items proposed other than GFE shall be provided for a minimum of one year from date of acceptance.

These will be discussed in more detail in the following sections, but in summarized form, the AOL has a need for expanding the VCS to support the increased number of workstations available during laboratory simulations.

4 Functionality and User Requirements:

4.1 System Configuration

The contractor shall expand the core capabilities of the voice communication system as follows:

- The VCS must be able to support a minimum of 84 voice clients.
- The VCS must be able to support organizing the voice clients into six workgroups.
- The VCS must be able to support a database of a minimum of 500 configurable circuits.
- Note: The system shall be expandable to install additional VCS solutions for ATM workstations, simulation support workstations, and recording capabilities as needed.

The contractor shall provide the equipment necessary for a central server that can support the above requirements as follows:

- One IP Central Equipment Unit (IPCEU) with dual quad core xeon CPUs (or similar) and other appropriate specifications.
- All appropriate licenses for access to server resources
  - talk/listen session licenses
  - 48-key client licenses
  - Voice loop access licenses
  - Two-channel audio licenses
  - Three-channel audio licenses
  - Soft-client access licenses
  - Etc.

The contractor shall provide fully integrated voice communication operator workstations as follows:

- Thirty-four VCS solutions for operator workstations, to be hosted on a small touch-screen tablet notebook PC, and where applicable, integrated with the AOL's existing equipment.
- Seven VCS solutions for other simulation support workstations (pseudo pilots, experimenters, etc.), functioning as a software application that can run in the background of a Windows PC simultaneously being used for other purposes.
- Note: the user interface of the integrated VCS solutions need to be identical to the user interface of the AOL's current VCS. This requirement is necessary to maintain consistency across operator positions, and to minimize training for both experimenters and operators.

Each VCS station shall be configured with all appropriate hardware (or specifications), software, firmware and licenses to provide networked Air to Ground (A/G), Ground to Ground (G/G) and Telephone (TEL) voice communications as defined within this SOW. Each VCS station shall also be configured to provide all appropriate hardware (or specifications), software, firmware and licenses required to affect administration, GUI design and development, voice communication application development, scenario development, operations, maintenance and network configuration of the VCS.

Individual VCS workstation equipment shall nominally include the following:

- Three separate GUI based touch screen interfaces to provide command and control of A/G, G/G and TEL voice communications.
- Two Plantronics USB PTT headsets.
- One USB PTT foot switch.
- Loudspeakers with independent volume control.
- Touch-screen Tablet PC for hosting VCS solutions.
  - Note: touch-screen must be operable with fingertip.
- One tablet stand.

The AOL does not want all VCS workstations to have all of the above listed hardware pieces. To address the AOL's specific needs, it is requested that the VCS expansion include a total of:

- Thirty-four touch-screen tablets
- Thirty-four tablet stands.
- Eighty Plantronics USB PTT headsets.
- Twenty-one USB PTT foot switches.
- Twenty-three loudspeakers with independent volume control

4.2 Multiple Workgroups

The VCS shall provide the capability to group voice clients in up to six separate workgroups (two more than the current VCS), producing shorter latency due to direct client-to-client communication between clients within a workgroup. Communication between clients across different workgroups will follow a client-to-server-to-client methodology, producing slightly longer delays. Refer to section 4.5 for more performance-related specifications.

4.3 Latency Performance

The VCS shall provide a minimum 8K bits/s sample rate. The maximum delay between push to talk and audio injection shall be less than 20 ms. System response to events like button pushes on the display screen and PTT switching shall be less than 20 ms. Total VCS latency performance not to exceed 250 ms under maximum utilization.

5 Support:

5.1 Spares

The supplier shall provide an itemized price list of recommended spares for the VCS rated as follows:

- Critical – system will not operate without this component
- Degraded – system will operate in a degraded mode
- Non-critical – all other components

5.2 Facility Integration Specifications

The contractor shall provide system requirements for cabling, power, HVAC etc. to the AOL at least one month prior to on-site installation. The AOL shall prepare the installation site per OEM installation requirements provided by the contractor.

5.3 Preliminary Test (PT)

The contractor shall notify the AOL at least two (2) weeks in advance of any PT being conducted at the contractor's facility. The AOL reserves the option to witness any PT conducted at the contractor's facility at the AOL's expense.

5.4 First Article Test (FAT)

The contractor shall provide the AOL with written verification of SOW compliance for all systems and subsystems tests conducted at the contractor's facility prior to shipment to the AOL. The contractor shall notify the AOL no later than (NLT) two (2) weeks in advance of any FAT being conducted at the contractor's facility. The AOL reserves the option to witness any FAT conducted at the contractor's facility at the AOL's expense.

5.5   *Installation*

The contractor shall provide personnel and equipment required to install Original Equipment Manufacturer (OEM) VCS equipment at the AOL. The equipment required at each VCS workstation is described in section 4.1.

5.6   *Integration*

The contractor shall provide personnel and equipment required to integrate OEM VCS equipment at the AOL. The contractor shall provide technical support required to integrate the OEM VCS equipment with GFE. The AOL shall provide the following GFE to the contractor for factory integration and testing of communication workstations. GFE equipment includes:
- Windows PC, running the 64-bit version of the Windows 7 Operating System.

5.7   *On-Site Validation Test (SAT)*

The contractor shall provide on-site validation testing of the VCS to verify SOW compliance of the integrated system. A discrepancy report (DR) shall be written for all items not meeting the requirements of this statement of work. The contractor shall provide on-site technical support, telephone support, e-mail support, subsystem (hardware or software) replacement/update, or remote system access support to clear all Discrepancy Reports (DR's) resulting from validation testing. The contractor shall provide on-site support for all discrepancies that cannot be resolved through off-site means

A certificate of compliance, signed by both the AOL and the contractor, shall be provided upon successful completion of the SAT and closure of all DR's.

6   Training:

6.1   *Operation and Maintenance*

The contractor shall provide operation and maintenance training and documentation to provide basic operating instructions for users and in-depth set-up, operation, maintenance, troubleshooting and upgrade training for technical support personnel.

Training shall be provided for up to 8 people at the customer site on a mutually agreed upon date. Operational, maintenance and technical support documentation shall be provided as part of the training

6.2   *GUI and Application Development*

The contractor shall provide comprehensive training and documentation for the use of any and all applications, utilities, tools and programming required to create, reconfigure or modify the GUI, runtime applications or functionality of the VCS system.

Training shall be provided for up to 8 people at the customer site on a mutually agreed upon date. Documentation shall include but not be limited to, user's guides, programmer's manuals, source code and licenses required for GUI and application support and development.

7   Program Management:

7.1   *Design Reviews*

The contractor shall conduct a Preliminary Design Review (PDR) and Critical Design Review (CDR) to discuss/resolve technical and contractual issues. Design reviews may be conducted by teleconference

between the AOL and the contractor. Each shall exchange agenda items via e-mail NLT one (1) week prior to the design review.

7.2 *Teleconferences*

The contractor shall originate or respond to requests for teleconferences as necessary to facilitate timely exchange of technical and programmatic information. To assure efficient teleconferencing, the contractor and the AOL shall exchange specific topics to be addressed via email.

7.3 *Agendas and Minutes*

The contractor shall publish, record, and distribute agendas and minutes for design reviews, conferences, teleconferences and meetings.

7.4 *Progress/Status Reports*

The contractor shall provide monthly status reports for all phases of the project. The contractor shall notify the AOL immediately upon discovery of issues affecting schedule.

7.5 *Interface Control Document (ICD)*

The contractor shall provide Interface Control Documentation for all hardware and software required to satisfy this SOW. The ICD shall include facility interface data in lieu of a separate Facility Requirements Document (FRD).

8 Support:

8.1 *Warranty*

The contractor shall provide one (1) year warranty for all VCS deliverables, contractor or third party, from the date of acceptance. The contractor shall transfer any remaining component or third party warranties to the AOL after the one (1) year warranty period.

8.2 *Technical Support*

The contractor shall provide technical support for the VCS for a period of one (1) year from the date of acceptance. Technical support includes telephone support for technical and troubleshooting issues as well as support for updates (including software, application or utilities), changes and modifications to the VCS.

9 Completion Date:

Delivery, installation and validation testing shall be completed No Later Than (NLT) October 15, 2011.